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rate at the original temperature. It was found that after a change in temperature, the corresponding change in respiratory activity took place only gradually, apparently not having reached an equilibrium even at the end of the third 20-minute period. Although the main point is proved, the value of this part of the work would have been increased by continuing the observations over a longer time.

Many students will regret that the author did not study oxygen consumption as well as the production of  $\text{CO}_2$ , to see whether the respiratory coefficient was altered by temperature changes. It should be remembered, too, that the conclusions reached may not hold good for other sorts of material, such as dormant seeds, the germination of which is greatly stimulated by alternations of temperature.—G. T. HARRINGTON.

**Ecology of bryophytes and lichens.**—Ecological studies of liverworts and mosses have not been numerous in the past, largely because bryologists have not been interested in ecology and ecologists have not been sufficiently acquainted with bryophytes. There are also some difficulties peculiar to the application of ecological principles to these plants. Some of these have been pointed out by WATSON<sup>4</sup> in attempting, among other things, to define a xerophytic bryophyte. This he decides must be a plant capable of withstanding long periods of dryness and of having at the end of such periods sufficient living cells to enable it to resume its growth quickly when water becomes available. He proceeds to consider the "xerophytic adaptations" under the two principal heads of structures causing (1) reduction of water output and those resulting in (2) water storage. The former is accomplished by such means as cushion forms, investments of dead cells, thick cell walls, leaf arrangement, and capillary structures; the latter by water sacs, water-storing cells, mucilaginous cells, and succulent tissue. The writer, however, warns us that many bryophytes exhibiting "xerophytic adaptations" are not xerophytes.

A second paper by the same author<sup>5</sup> gives in detail the zonation of bryophytes in a wet heath. The shallow water zone is dominated by *Aneura pinguis*, *Pellia epiphylla*, *Hypnum scorpioides*, and *Sphagnum cymbifolium*; the second zone, just above water level, is dominated by *Aneura multifida*; a third zone consists of *Sphagnum subnitens*, *Hypnum intermedium*, and associated forms, passing imperceptibly into a fourth zone, characterized by *Hypnum cuspidatum*, and closely followed by a fifth zone dominated by *Brachythecium pyrum* and *Cephalozia connivens*. This is frequently the end of the series, although occasionally the drier tussocks show a sixth zone of *Hypnum cupressiforme* var. *ericetorum*. Drainage and the accumulation of humus are the chief

<sup>4</sup> WATSON, W., Xerophytic adaptations of bryophytes in relation to habitat. New Phytol. 13:149-169, 181-190. 1914.

<sup>5</sup> ———, A Somerset heath and its bryophytic zonation. New Phytol. 14:80-93. 1915.

factors in determining the succession. The probable history of the heath is well discussed and the diagrams are decidedly good and appropriate.

A remarkable instance of the vitality of moss protonema is recorded by BRISTOL,<sup>6</sup> who found resting protonemal cells, rich in oil, in dry soil stored in air-tight bottles for 46-49 years. In cultures these grew and produced protonema of the ordinary type.

In a series of notes WEST<sup>7</sup> has recorded the bryophytes and lichens found upon trees in parts of Scotland, Wales, and Ireland, and has arranged them according to abundance. He has found the percentage ratio of some of the principal forms to be: *Stereodon cupressiformis* 16, *Parmelia saxatilis* 6, *Isothecium myosuroides* 2, *Frullania dilatata* 2, *Parmelia fuliginosa* 2, *Lecanora tartarea* 2, and *Platysma glaucum* 1.—GEO. D. FULLER.

**Variations in wood structure.**—Several recent articles have called in question some of the "laws of Sanio" for variation in the size of tracheids in conifers, more particularly that law which states that tracheids increase in size from the pith radially outward until they reach a definite size, which remains constant for the following annual rings. SHEPARD and BAILEY<sup>8</sup> found the gradual increase in size up to 30-60 years, but in succeeding years no constant length was attained. Later the same authors maintained their points in this journal.<sup>9</sup>

Their results were for the greater part confirmed by a detailed study of *Pinus palustris* and *Pseudotsuga* by Miss GERRY,<sup>10</sup> who also finds the longest tracheids in the early spring wood and the shortest in the late wood. LEE and SMITH<sup>11</sup> now supplement this with an extended study of *Pseudotsuga* from British Columbia. Their results, in general, agree with those already cited except that after a gradual and fairly rapid increase up to the age of 50 years the tracheid length varies comparatively little, but tends to increase slightly. They also find an increase in tracheid length up to 42 ft. above the ground, and then a gradual decrease up to 154 ft., where the measurement ceased. It is interesting also to note that trees from the coast region appear to have slightly longer tracheids than those from the mountains.

<sup>6</sup> BRISTOL, B. MURIEL, On the remarkable retention of vitality of moss protonema. New Phytol. 15:137-143. 1916.

<sup>7</sup> WEST, W., Ecological notes; chiefly cryptogamic. Jour. Linn. Soc. 43:57-85. 1915.

<sup>8</sup> SHEPARD, H. B., and BAILEY, I. W., Some observations on the variation in length of conifer fibers. Proc. Soc. Amer. Forest. 9: 1914.

<sup>9</sup> BOT. GAZ. 60:66-71. 1915.

<sup>10</sup> GERRY, ELOISE, A comparison of tracheid dimensions in longleaf pine and Douglas fir. Science 43:360. 1916.

<sup>11</sup> LEE, H. N., and SMITH, E. M., Douglas fir fiber, with special reference to length. Forest Quart. 14:671-695. 1916.